Detection and Identification of Unexploded Ordnance

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RESEARCH OBJECTIVES

A recent Task Force Report lists some 1,500 sites comprising approximately 15 million acres that potentially contain unexploded ordnance (UXO). In practice, the major costs in cleanup are excavation and removal, but at present, 90% of the objects detected are non-UXO, and 75% of the cost of excavation is for these non-UXO objects. Existing systems can detect metallic objects in the ground, but cannot discriminate between the generally cylindrical and symmetric intact UXO and the scraps or fragments of exploded UXO that are harmless (Figure 1). It is the objective of this research to design and fabricate an optimum active electromagnetic (AEM) system that can extract from the measurements the best possible estimates of the location, size, shape, and metal content of a buried metallic object—in the presence of interfering responses from the ground and non-UXO metallic objects.

APPROACH

These objectives are being realized through simulators: numerical models of the electromagnetic response, produced by an arbitrary target in the ground, to an arbitrary configuration of transmitters and receivers. The simulators are then used for the forward calculations required in inverse solutions for (a) the depth, size, and aspect ratio of a target and (b) the configuration of the transmitters and receivers to optimize the calculations in (a).

ACCOMPLISHMENTS

We have found that the depth, size, and principal moments (any target can be represented by three orthogonal principal dipole moments) can be derived from the response of a system consisting of three orthogonal transmitters and five sensitive induction-coil sensors mounted within a 1 m × 1 m frame. Because of these findings, the project emphasis has shifted to making magnetic field sensors and instrumentation that can achieve measurement bandwidths (or time windows) that meet the specifications of the simulations. Since optimum determination of depth and orientation requires multiple-point sensors (arrays of compact sensors), we have developed small induction sensors to replace the large open-loop sensors currently used in all AEM systems.

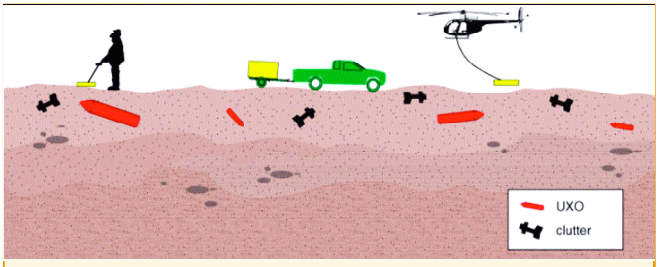

Figure 1. Conceptual representation of UXO in presence of clutter and geological noise

SIGNIFICANCE OF FINDINGS

We have designed a new generation of multisensor electromagnetic systems that can significantly extend the depth of UXO detection and, more importantly, determine key parameters of the object that will differentiate it from harmless scrap metal.

ACKNOWLEDGMENTS

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